Naval Shipbuilding Expansion: The World War II Surface Combatant Experience

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Introduction

- The post-Cold War “Peace Dividend” era is over
- “Overt challenges to the free and open international order and the re-emergence of long-term, strategic competition between nations.” (DoD 2018)
- Possibility of non-nuclear, industrial-scale war has re-emerged.

What can we learn from the last time we engaged in industrial-scale war?

U.S. Destroyer Acquisition Eras

World War I Era (up to 1922)

- 68 destroyers commissioned prior to U.S. entry into WW I
  - One would serve in WW II
- 273 “Flush-Deckers” acquired in response to U.S. entry into WW I
  - 41 commissioned prior to end of hostilities
  - The rest were commissioned after WW I
  - 105 lost or scrapped prior to WW II, remainder served in WWII

Treaty Period (1922-1936)

- Limitations placed on displacement, weapons, and number
- Torpedo tubes and 5 inch guns were the primary weapon systems
- 61 destroyers in seven classes procured

Pre-War (1936-1941)

- Designs modified to reflect experiences of foreign navies in combat
  - Lend-Lease prepared industry for production ramp-up
- 182 destroyers in four classes authorized
- 39 in commission upon U.S. entry in WW II

World War II (1941-1945)

- Industrial production of destroyers
- Predominately *Fletcher* class and *Sumner* class
- *Gearing* class started to arrive in mid-1945

USS *Fletcher* (DD 445) underway off New York, 18 July 1942
(www.history.navy.mil – 19-N-31245)

USS *Compton* (DD 705) off New York, 25 October 1944
(www.history.navy.mil – 80-G-288078)

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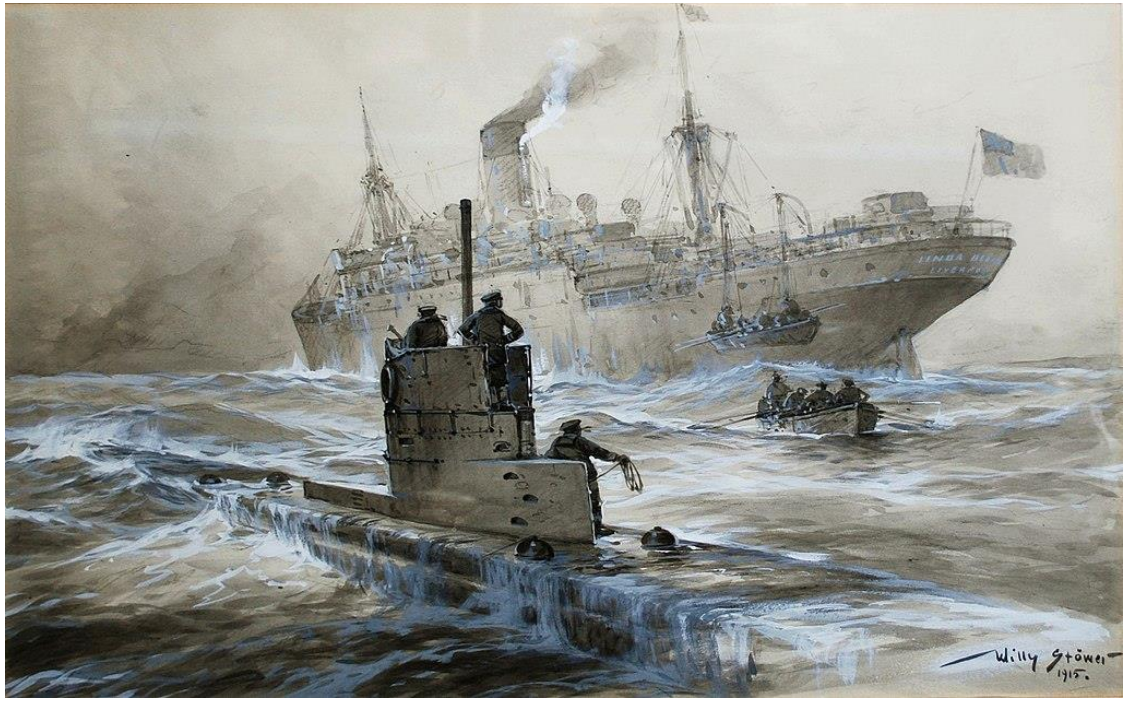
WWI Naval Timeline

- 28 July 1914: Austria declared war on Serbia
- 1914: First convoys for troopships
- 1915: Naval Blockade of Britain
- 7 May 1915: *Lusitania* sunk
- Spring 1916: Ship tonnage sunk exceeds new tonnage delivered
- 31 May 1916: Battle of Jutland
- Early 1917: German U-boat campaign
- 6 April 1917: U.S. declares war on Germany
- June 1917: Regular transoceanic convoys begin
- 1918: North Sea Mine Barrage
- 11 Nov 1918: Armistice signed



Sinking of the *Linda Blanche* out of Liverpool by SM U-21

(Willy Stöwer)

- Sink submarines
- Build cargo ships faster than they can be sunk

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Naval Vessels Delivered by Year

Year	No.	Displacement tonnage	Average displacement	No. of battleships	No. of cruisers	No. of torpedo boats	No. of destroyers	No. of submarines	No. of other types
1898	12	28,111	2,343		1	3			8
1899	8	24,259	3,032	2					6
1900	6	13,349	2,225	1		3		1	1
1901	8	24,550	3,069	2		1			5
1902	17	24,560	1,445	1					16
1903	15	24,573	1,638	1	1			6	7
1904	5	22,362	4,472	1	3				1
1905	9	72,505	8,056		7				2
1906	10	140,192	14,019	6	4				
1907	9	90,743	10,083	4	2			3	
1908	9	85,435	9,493	3	5			1	
1909	16	81,135	5,071	2			4	6	4
1910	12	77,385	6,449	2			7	1	2
1911	12	61,872	5,156	2			9		1
1912	17	77,598	4,565	2			6	7	2
1913	11	81,849	7,441				4	3	4
1914	20	66,080	3,304	2			4	10	4
1915	11	33,765	3,070				7	1	3
1916	22	160,805	7,309	4			9	7	2
1917	16	77,289	4,831	1			5	5	5
1918	89	155,642	1,749	1			44	36	8
1919	157	221,255	1,409	1			104	22	30
1920	94	171,141	1,821	1			79	10	4
1921	40	172,974	4,324	2			28	5	5
1922	12	24,286	2,024	one aircraft carrier			3	8	1

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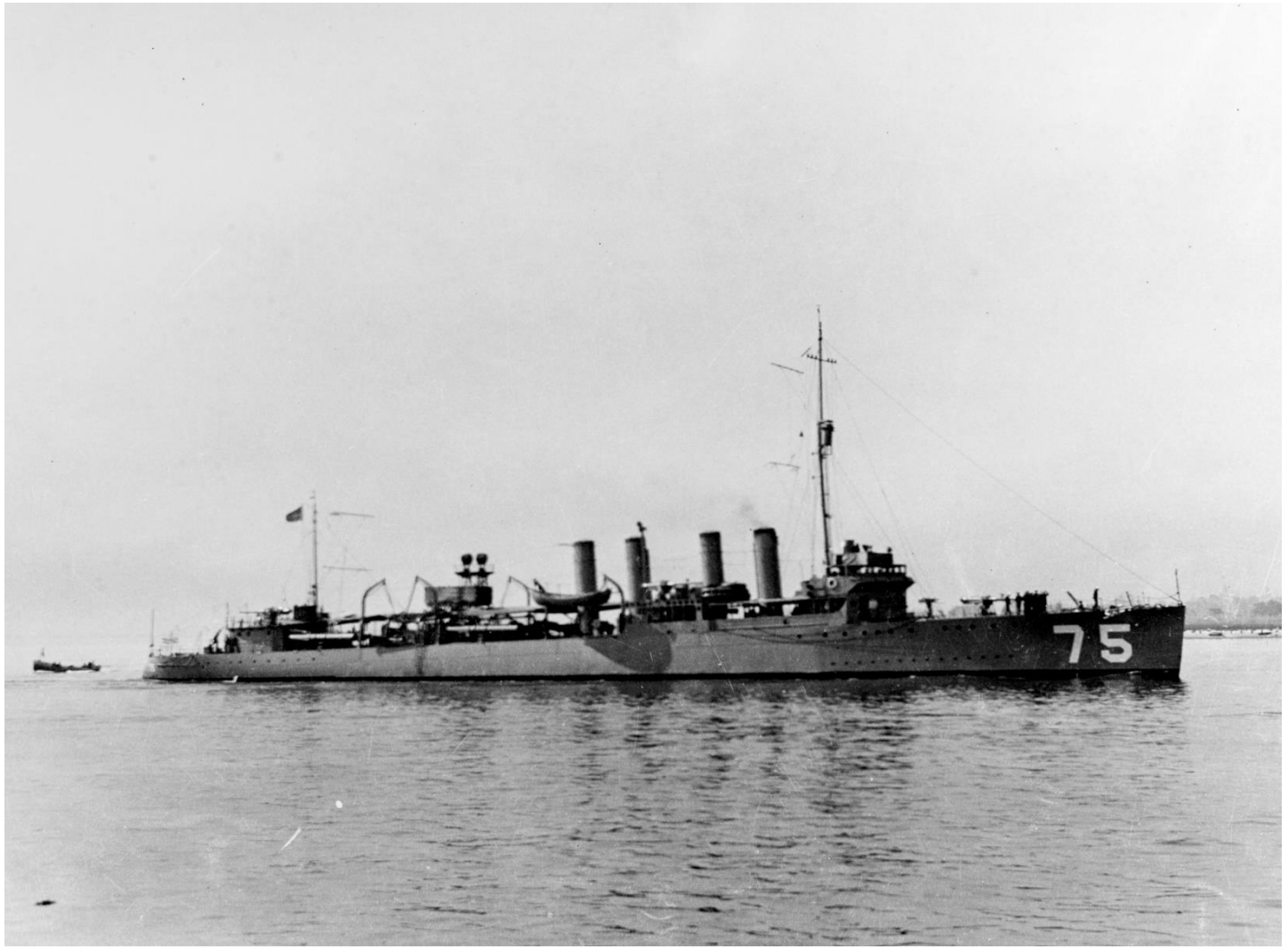
U.S.S. Wickes (DD 75)

- Laid down: 26 June 1917
- Launched: 25 June 1918
- Commissioned 31 July 1918
- Convoy escort in WWI
- 1,247 tons full load
- Length: 314’ 4.5”
- Armament
  - 4 x 4”/50 guns
  - 2 x 1 pounder guns
  - 12 x 21 inch torpedo tubes
- Crew: 100 officers and enlisted



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Shipyards that build major warships from 1913-1922

Shipyard	Location	Major warship types built
Bath Iron Works	Bath, Me.	Destroyers
Bethlehem Shipbuilding Corp. (Fore River)	Quincy, Mass.	Battleships, destroyers, submarines
Bethlehem Shipbuilding Corp.	Squantum, Mass.	Destroyers
Bethlehem Shipbuilding Corp. (Union Iron Works)	San Francisco	Destroyers, submarines
California Shipbuilding Co.	Long Beach, Calif.	Submarines
Craig Shipbuilding Corp.	Long Beach, Calif.	Submarines
Cramp, William and Sons	Philadelphia, Pa.	Destroyers, submarines
Electric Boat Co.	Groton, Conn.	Submarines
Lake Torpedo Boat Co.	Bridgeport, Conn.	Submarines
The Moran Co.	Seattle, Wash.	Submarines
Newport News Shipbuilding and Dry Dock Co.	Newport News, Va	Battleships, destroyers
New York Shipbuilding Corp.	Camden, N.J.	Battleships, destroyers
Seattle Construction and Dry Dock Co.	Seattle, Wash.	Destroyers, submarines
Charleston Navy Yard	Charleston, S.C.	Destroyers
Mare Island Navy Yard	Vallejo, Calif.	Battleships, destroyers
New York Navy Yard	Brooklyn, N.Y.	Battleships
Norfolk Navy Yard	Portsmouth, Va.	Aircraft carriers, destroyers
Portsmouth Navy Yard	Portsmouth, N.H.	Submarines
Puget Sound Navy Yard	Bremerton, Wash.	Submarines

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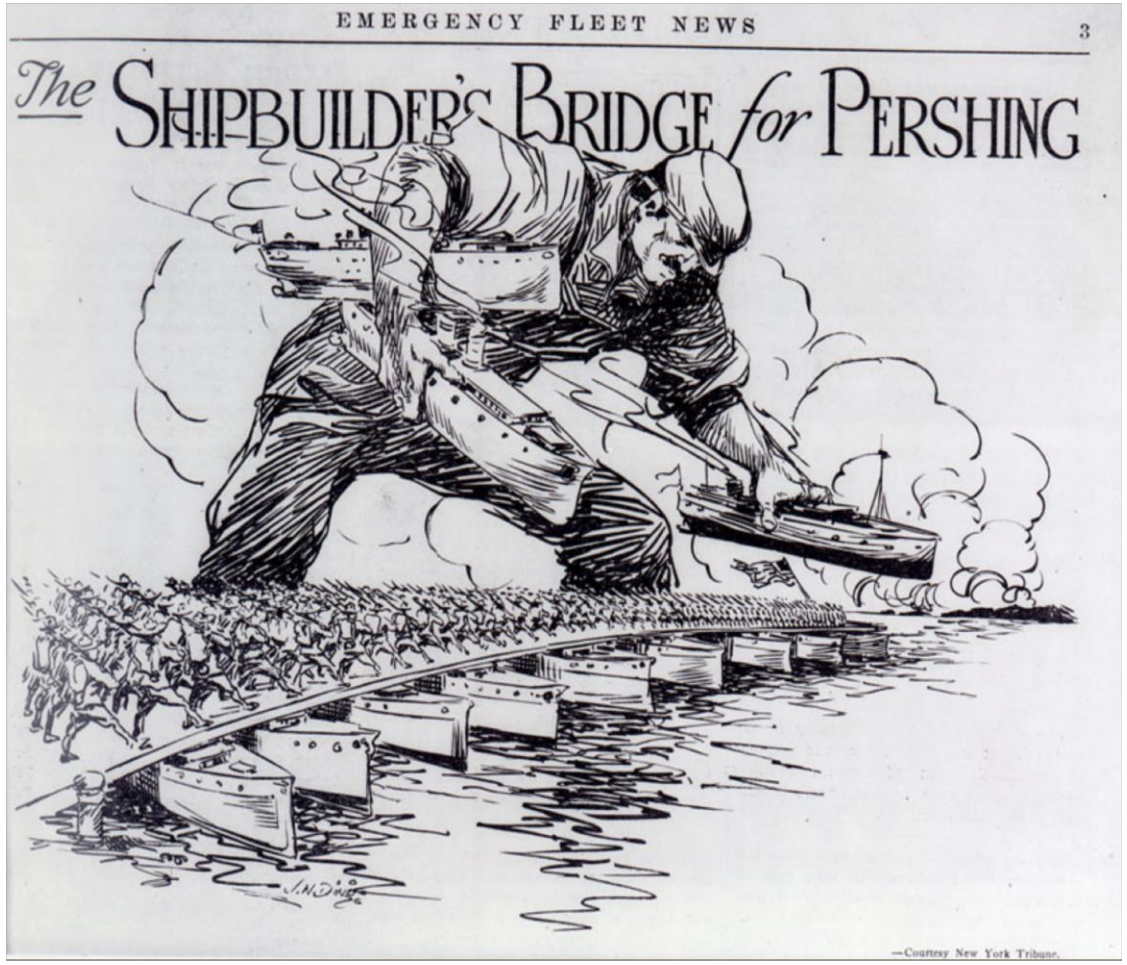
World War I propaganda featuring the United States Shipping Board (USSB) and the Emergency Fleet Corporation



Sources: https://docsouth.unc.edu/wwi/41892/50.html accessed Feb. 10, 2019,
http://americanhistory.si.edu/onthewater/exhibition/6_2.html accessed Feb. 11, 2019

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Merchant Shipbuilding in WWI: Emergency Fleet Corporation Yards

Firm	Shipyard location	No. of ships delivered to USSB	No. delivered to USSB before Nov. 1918
East Coast (13 yards)			
American International Shipbuilding	Hog Island, Pa.	122	0
Atlantic Corporation	Portsmouth, N.H.	10	0
Carolina Shipbuilding	Wilmington, N.C.	8	0
Downey Shipbuilding	Arlington, N.Y.	10	0
Foundation Company	Kearny/Newark, N.J.	10	5
Merchant Shipbuilding	Bristol, Pa.	40	0
Newburgh Shipyards	Newburgh, N.Y.	12	0
Pusey and Jones	Gloucester City, N.J.	20	3
Standard Shipbuilding	Shooters Island, N.Y.	23	7
Submarine Boat Company	Newark, N.J.	118	0
Terry Shipbuilding	Savannah, Ga.	11	0
Texas Steamship Company	Bath, Me.	4	4
Virginia Shipbuilding	Alexandria, Va.	12	0
Gulf Coast (7 yards)			
Oscar Daniels Shipbuilding Company	Tampa, Fla.	10	0
Doullut and Williams	New Orleans, La.	8	0
Foundation Company	New Orleans, La.	5	0
Mobile Shipbuilding	Mobile, Ala.	14	1
National Shipbuilding	Orange, Tex.	12	1
National Shipbuildng Corporation	Violit, La.		
Pensacola Shipbuilding	Pensacola, Fla.	10	0
Midwest (2 yards)			
Globe Shipbuilding	Superior, Wis.	19	4
Saginaw Shipbuilding	Saginaw, Mich.	18	2
West Coast (10 yards)			
Ames Shipbuilding and Dry Dock Company	Seattle, Wash.	25	7
Columbia River Shipbuilding	Portland, Ore.	32	8
J.F. Duthie and Company	Seattle, Wash.	27	12
Hanlon Dry Dock and Shipbuilding Company	Oakland, Calif.	11	4
Northwest Steel	Portland, Ore.	34	13
Pacific Coast Shipbuilding	Bay Point, Calif.	10	0
Seattle North Pacific Shipbuilding	Seattle, Wash.	10	0
Skinner and Eddy	Seattle, Wash.	40	25
Supple-Bollin Shipbuilding	Portland, Ore.	12	8
Union Construction Company	Oakland, Calif.	10	0
	Sum:	707	104

Most ships delivered after the Armistice

Riveting crew at Hog Island, 1919

http://americanhistory.si.edu/onthewater/exhibition/6_2.html

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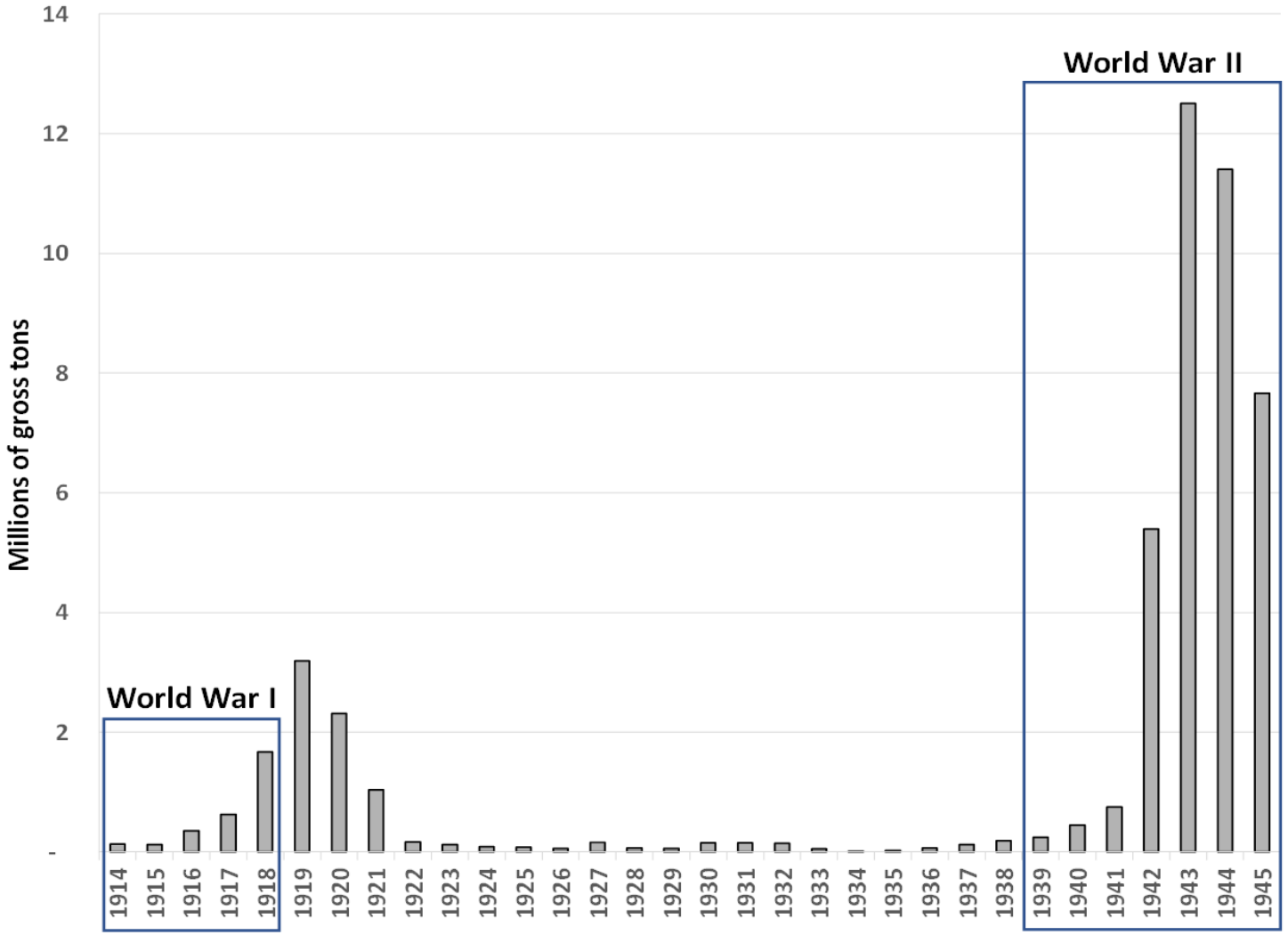
Gross tons of steel merchant ships (over 2,000 gt) delivered, 1914-1945; time-slots of World War I and World War II involvement are indicated



Data:
Smith and Brown, 1948

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Observations

- World War I shipbuilding program was not effective because it started too late.
  - —Started with Shipping Act of 1916 and Naval Act of 1916
  - —Peak production was in 1919
  - —Lasted through 1922
- The types of ships needed in quantity during the war differed from the types built prior to the war.
  - —Pre-war: Battleships and cruisers
  - —During the war: Destroyers and submarines
- The industrial expansion effort was impressive and served as a “trial run” for World War II.

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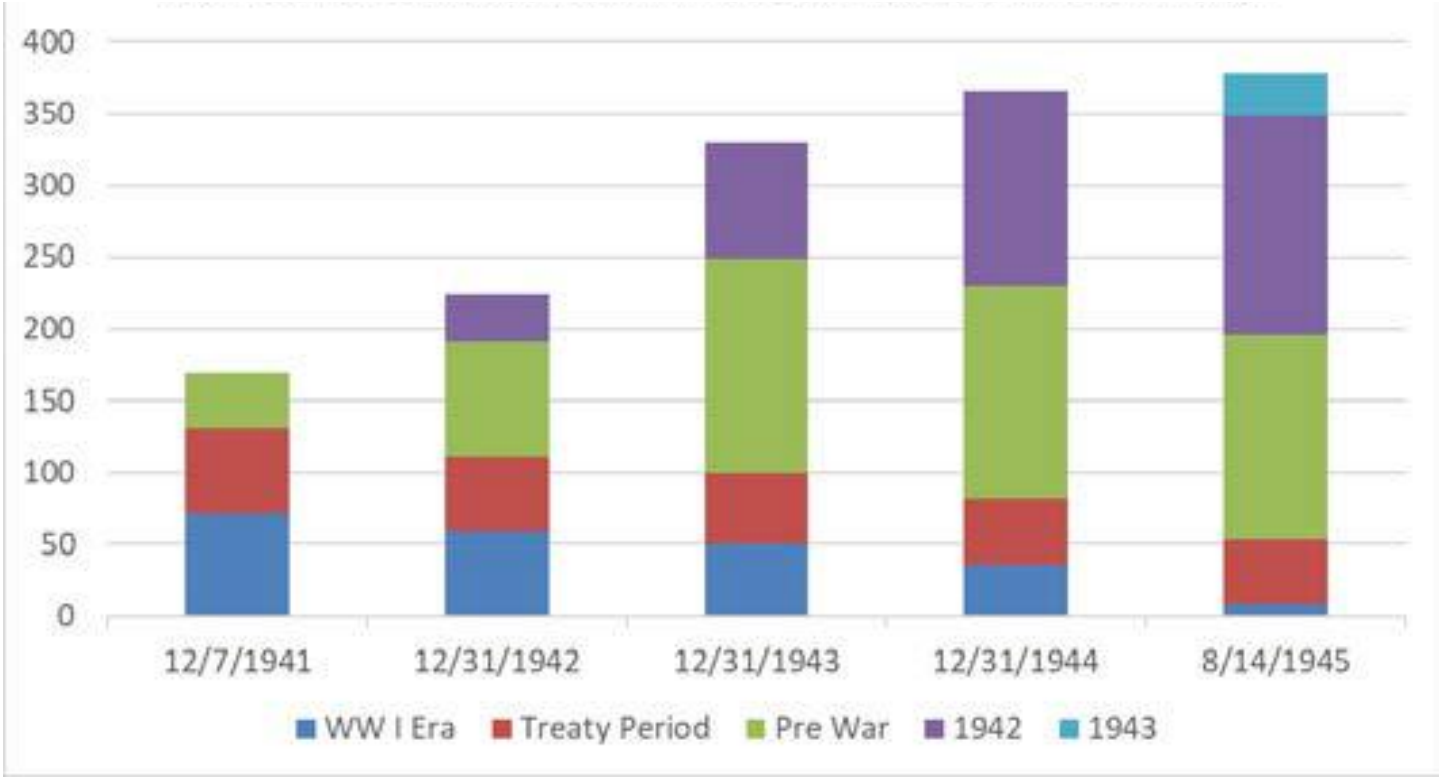
Fleet composition is based on past decisions

Number of destroyers in commission on specific dates



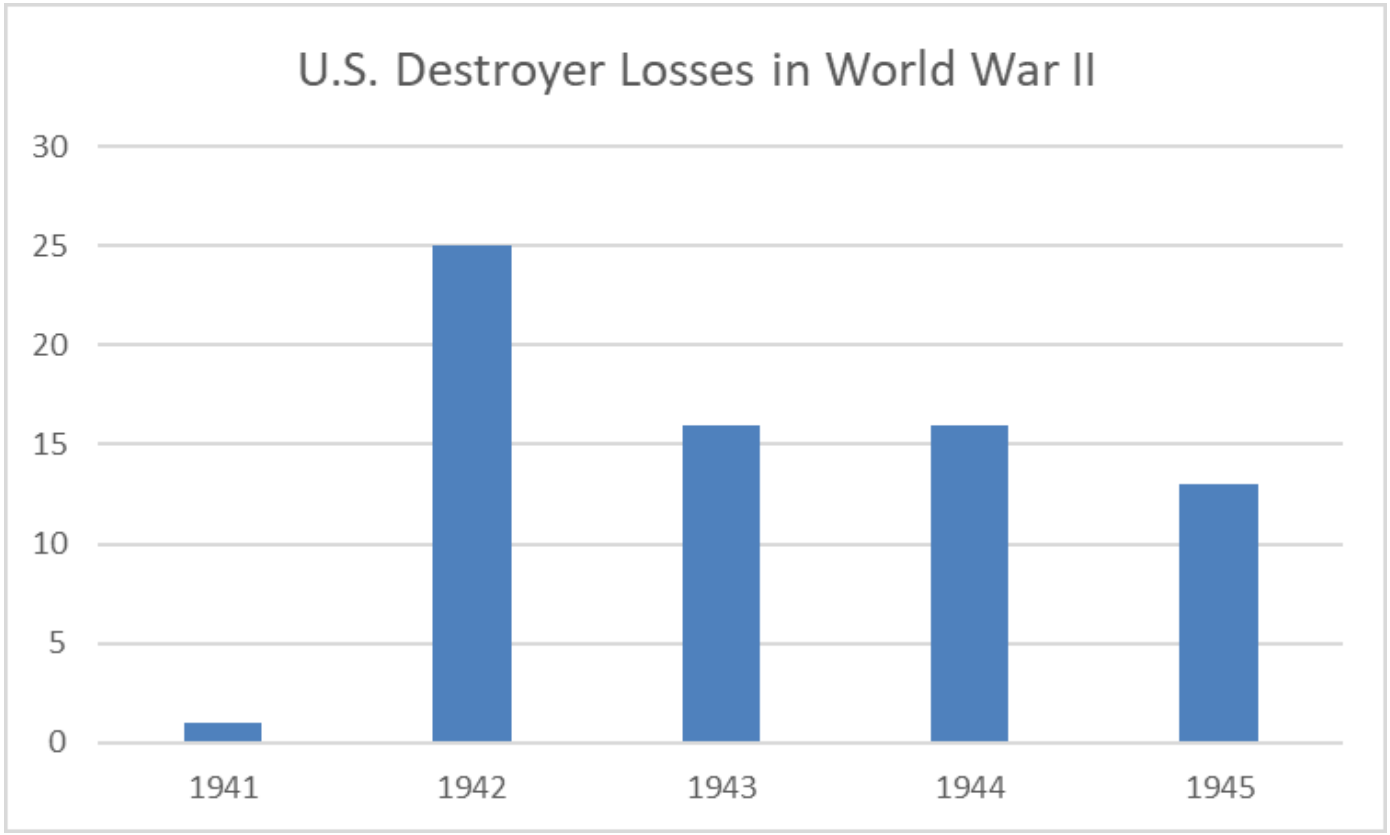
Era / Year Authorized

"As you know, you go to war with the army you have, not the army you might want or wish to have at a later time."

- Donald Rumsfeld, 2004

U.S. Destroyer Losses in World War II

- 71 destroyers lost
- Heaviest losses early in the war
  - —All from Pre-war or earlier
- 20 destroyers lost between November 1944 and end of the war
  - —14 from Kamikaze attack
  - —3 from typhoon
  - —1 from gunfire
  - —1 from torpedo attack
  - —1 from mine

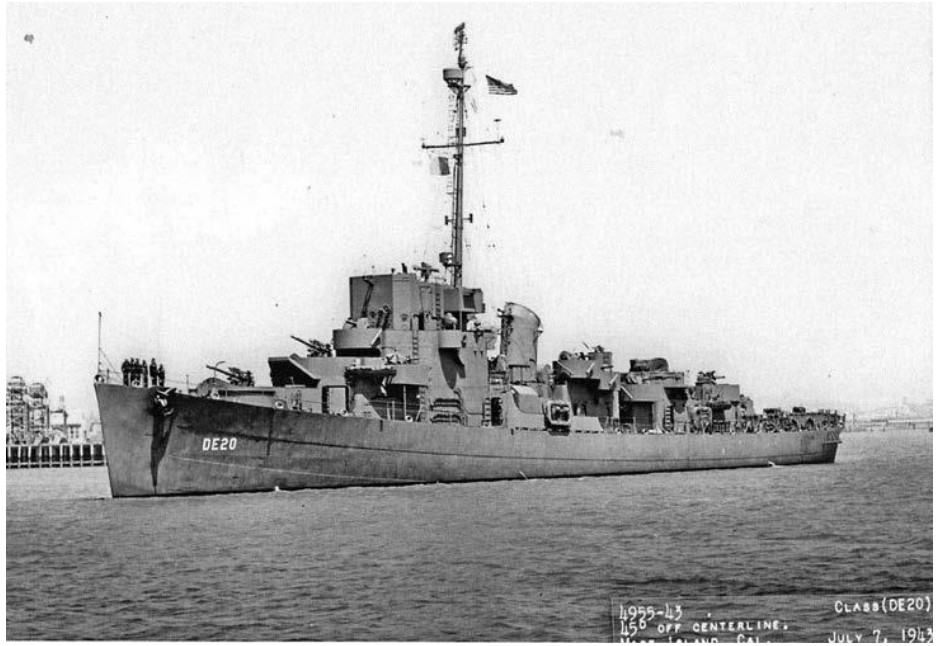


"All warfare is a race between belligerents to correct the consequences of the mistaken beliefs with which they entered combat."

- Gray (2006)

World War II Observations

- **Ships designed during the war were not commissioned in time to participate in combat or were cancelled.**
  - Notable exception were the LSTs
- **Construction of Battleships limited by production capacity of armor**
  - May have contributed to the rise of the Aircraft Carrier
  - 4 Battleships and 18 aircraft carriers constructed during WW II
  - Industrial Base production capacity is closely related to tactics employed
- **Destroyer armament adapted to changes**
  - Pre-war: Torpedoes considered the primary weapon
  - Early war: Combat Information Centers (CIC) formed to fuse sensor data
  - Early war: .50 cal machine guns replaced by 20 mm. 1.1 inch guns by 40 mm.
  - Late war: Torpedo tubes replaced with 40mm Anti-aircraft guns in response to Kamikaze.
- **Destroyer escort acquisition adapted to industrial base capacity**
  - Reflected in six distinct classes with radically different propulsion plants
    - Diesel electric, Steam turbine electric, diesel reduction gear, steam turbine reduction gear
  - Of 563 completed, 254 only had the half the designed horsepower with a loss of 3 knots (21 vice 24 knots).



USS LeHardy (DE 20) in the Mare Island Channel, 1943. This ship is of the Evarts class, which was fitted with diesel-electric drive of half the originally designed shaft horsepower (Silverstone 1965).

(http://www.navsource.org/archives/06/images/020/0602016.jpg accessed 28 May 2018).

Lessons for Today

- Much of the fighting is likely to be done by the ships in the fleet at the start of hostilities.
- With few exceptions, ships designed during wartime will not enter the fleet in numbers prior to the end of the fighting. “Only equipment in production can pass into mass production” (Friedman 2004).
- High volume production will not happen without expansion in industrial capacity, both in the shipyards and in their supply chains. This will delay high rates of ship delivery.
- Shortages of key components and materiel will likely require rapid design modifications. Flexible relaxation of key performance parameters will likely be necessary in order to incorporate substitutions.

Lessons for Today (continued)

- Speed of construction and battle damage repair will in large part determine fleet composition and thus the tactics that can be employed.
- Useful ships that can be procured fast and then promptly sent to sea, will have more relevance than exquisitely capable vessels requiring a protracted design-build-testing effort.
- Ships, weapons, and tactics will evolve rapidly and unexpectedly once the bloodshed starts. Speed of adaptability is of the essence.
- Modernization of a ship class is time consuming. Ships in modernization are not available for combat; hence upgrades must be phased in over time (not done in blocks) to enable enough ships to remain in the fight.

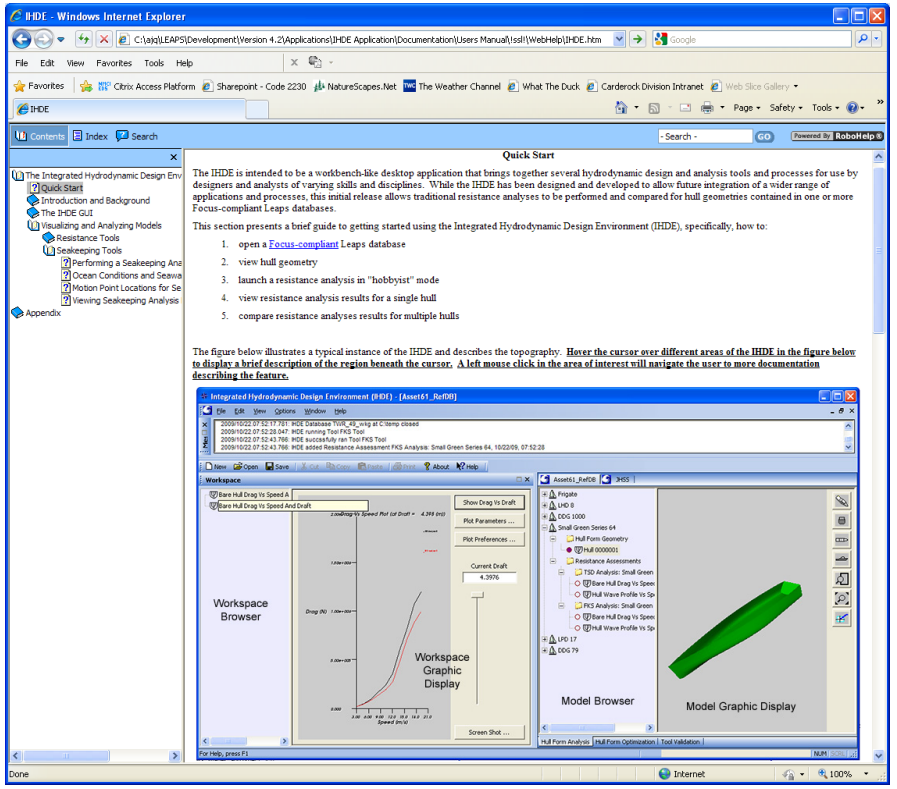
Implications for mobilization

- First year of conflict may see very intensive combat
  - —High losses (perhaps 2+ destroyers a month)
  - —Rapid learning
  - —Need for fast Adaptation
- Requires an order of magnitude increase in destroyer production rate.
  - —Replace losses
  - —Build up numbers to dominate an adversary
  - —If possible, the ship construction ramp up and the expansion of shipyard and supply chain production facilities should start prior to the start of hostilities, as was done in World War II.

The future USS RALPH JOHNSON (DDG 114) launched at the Huntington Ingalls Industries shipyard (Photo courtesy of Huntington Ingalls Industries).

Recommendations

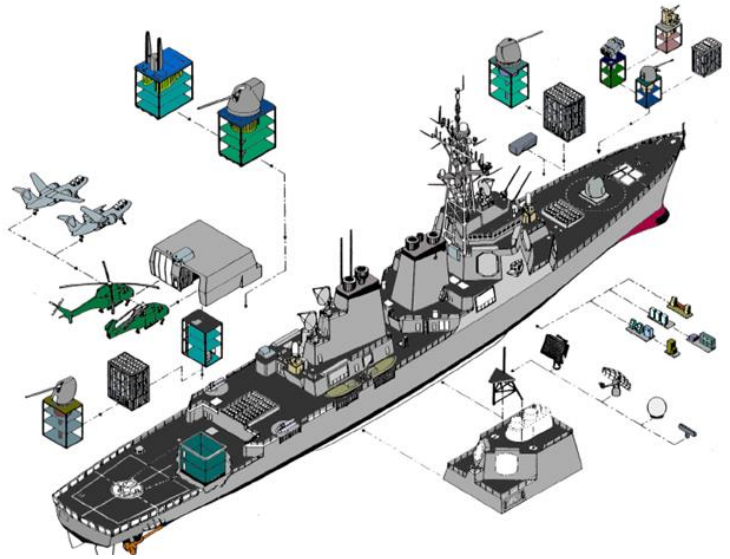
- Use modern digital modeling and simulation for ship design. Maintain digital models of all ships.
- Build digital simulation models of the industrial base and use them to evaluate product designs, bottlenecks, and capital improvements in the shipyards and in the critical supply chain production facilities.
- Run the digital ship preliminary designs through the digital industrial base simulation models prior to freezing the key performance parameters.
- Implement rigorous design-for-production and link it to industrial base modeling and simulation, to ensure that the designs are producible.
- Configure the ship design to enable substitution of key components that may have limited availability.



Courtesy Adrian Mackenna

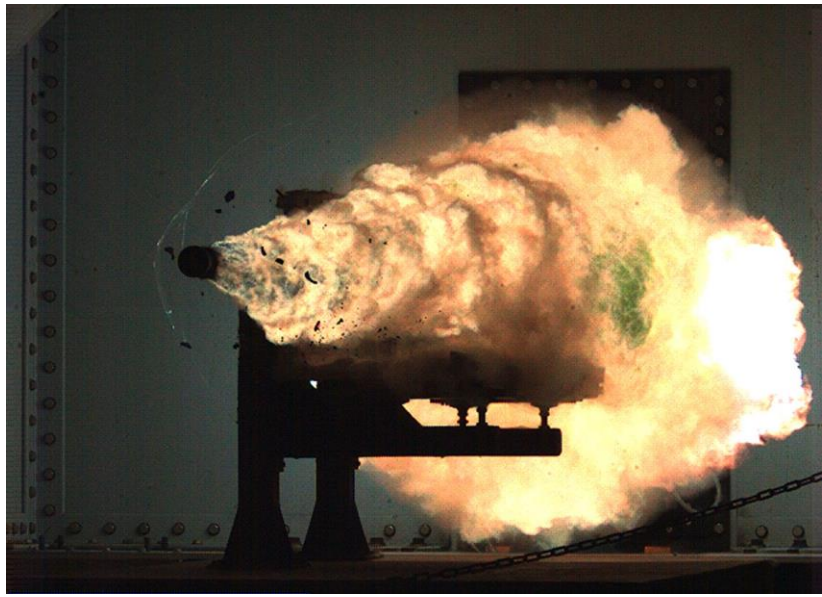
Recommendations (continued)

- Provide for integration of the combat systems in a facility other than the shipyard. Dis-aggregate the payload from the hull, mechanical, and electrical (platform) work.
- Incorporate modularity and adaptability in warship designs.
- Take advantage of modularity and adaptability to incorporate major changes in ship weapon systems.
- Incrementally modify the ship design to reflect feedback from the fleet.
- Design warships to be survivable; to preserve the force structure in the face of enemy action.



Conclusions

- Naval ship acquisition processes have evolved during nearly three decades of a post-Cold War era marked by the absence of a threat of peer-level naval combat.
- Reorientation towards meeting the challenges of potential peer level, non-nuclear, industrial-scale war will require new thinking.
- In some key respects, the new geopolitical/naval strategic environment confronting the U.S. Navy more closely resembles that of the pre-World War II era than the more recent post-Cold War era.



U.S. Navy Photo